

***Anthocephalus chinensis* (Lam.) A. Rich. ex Walp. Kadam**

Rubiaceae Madder family

Ariel E. Lugo, Julio Figueroa

U.S. Forest Service
Pacific Southwest Laboratory and Information Center
1323 Club Drive
Vallejo, CA 94592-1110

HABITAT

Anthocephalus chinensis, or kadam, is a fast-growing deciduous tree found in gallery forests in its native Asian range. There are over 40 common names in Asia; see 3, 7, 10, 15, 16, 23, 25, 27, 56, 59, 64. Its natural range extends from latitudes 10°S to 30°N, through India, the Malay peninsula and archipelagos, Nepal, Sri Lanka, Vietnam, Burma, Indonesia, Australia, Papua New Guinea, the Philippines, and China (15, 16). Although kadam grows well on the roadsides of Sabah (15), it generally prefers riverbanks between frequently flooded soils and periodically flooded drier loams. Kadam trees are conspicuous due to their broad decussate branches with large entire leaves and their copious production of edible, fleshy, fragrant fruits.

Climate

Kadam can grow in a wide range of rainfall conditions (150–5000 mm/yr) with or without pronounced dry seasons (52, 63). However, it grows best in subtropical and tropical moist forest, and tropical and subtropical lower montane wet and rain forest life zones (*sensu* Holdridge). Mean annual temperature in its native habitat ranges from 3.3° to 37.7°C (63). The tree is also reported to be frost sensitive (20).

Soils and Topography

Kadam grows well in deep, moist, well-drained loams and on alluvial soils with high fertility from 0 to 1000 m above sea level (asl). It also occurs in clays and clay-loams derived from sedimentary shales, sandstones, and mudstones (15). Kadam may invade soils intensively altered by logging and maintain dominance for about 40–45 years (36), but it will not grow well in dry, heavy-textured, or nutrient-poor soils (15, 63). High soil compaction (1.8 kg/cm³) and low litter accumulation (236 g/m²) were reported in the Philippines (33).

Associated Forest Cover

Kadam is a pioneer species in gallery forests and associated riverine wetlands. As a pioneer, it grows with other successional species as well as with the dipterocarps that eventually dominate the sites (36). In the Philippines, kadam is associated with *Octomeles sumatrana* and *Pterospermum* sp. and grows well with *Albizia falcata* (5). In a subtropical moist forest in India, kadam was reported growing with 19 other tree species (51).

Principal Plant Ecologist and Forestry Technician, respectively, Institute of Tropical Forestry, Southern Forest Experiment Station, Rio Piedras, Puerto Rico.

LIFE HISTORY**Reproduction and Early Growth**

Flowering and Fruiting.—Flowering generally begins at 4 to 5 years, although there are reports of trees flowering after 2.5 years (5). Different flowering seasons have been reported throughout the range of kadam; e.g., India: May–July with fruit ripening and falling in January–February (60); Sabah: June–September with fruit ripening in December–February (15, 47); Philippines: April–June with fruit ripening in September–February (5, 37); and September in Sri Lanka (64). Bees are attracted to the small, sessile, and entomophilous flowers. These are set in stalked, round, burr-like heads, each separate from the others (10). Fruits are multiple, composed of tiny capsules that split into four parts with minute seeds. The numerous capsules are formed on the fruiting head, which is rather fleshy (10). Mature fruits are yellow to yellow-orange, have a fragrance, and contain about 8,000 seeds.

Seed Production and Dissemination.—Kadam seeds are very small (20,000/g [15]; 17,000/g [air dry, 47]). Dispersal of seeds occurs while the fruits are still on the tree (birds and bats) and after they have fallen (cattle, ants, and other animals (15, 47).

Seedling Development.—Germination in kadam is epigeous (60). Freshly extracted seed has germinated extremely well in nurseries without after-ripening or cold storage. Seeds have also germinated on tissue paper covering sterilized, sandy soil-vermiculite germination media (61), and on a soil-sand mixture watered through capillarity (21). In the shade, 6,646 seedlings/g of pure seed have been germinated (21). In sunlight, with watering by aspersion, 2,825 seedlings/g of pure seed germinated with 89% survival after 12 weeks (21).

Methods for seed extraction, using sequences of maceration in water, drying, pounding, and decanting, and repeating the process through a series of sieves, have been described (45, 47). Dry seeds can be extracted without watering or artificial drying (61).

Seed stored for 2 years in air-tight containers at 5° to 10°C yielded good germination (47). In the same study, poor germination was obtained when storage was under 6 months. Germination under full sunlight has been reported to occur from 4 to 16 days after sowing, with peak germination between 7 to 14 days (21, 47). Seed can be extracted with 98% purity and 90% germination (61) using a modification (dry extraction) of the methods given in 21 and 47.

The same nursery procedure normally used for *Eucalyptus* can be used for kadam (47). Germination beds should be watered 2 to 3 times/day with a fine spray. When seedlings reach 2.5 cm tall (3 to 4 weeks) and have 2 to 3 pairs of leaves, they can be pricked out. Shading should be decreased to about 50% of full sunlight by pricking time.

Planting occurs 3 months after pricking out. Another study showed that shade may be reduced to 30% during germination, and seedlings may be transplanted after 25 days when they are 2.5 cm tall (61).

As many as 45,000 seedlings/ha have been recorded under natural regeneration conditions, and higher numbers have occurred in tractor tracks and disturbed soil (15). In the field, germination of old seed was best under full sunlight, while young seed germinated in 25% shade; germination took 3 weeks in both instances (15).

Seedlings are drought-sensitive (60) and need frequent watering. They have stomata on both sides of the leaves ($42/\text{mm}^2$ on the upper side and $525/\text{mm}^2$ on the underside [54]). Maximum and average daytime net photosynthesis is 0.29 and 0.20 $\text{gC}/\text{m}^2\cdot\text{hr}$ respectively and nighttime respiration rates are low ($0.1 \text{ gC}/\text{m}^2\cdot\text{hr}$ [31]).

Seedling response to fertilizers is variable. Some seedlings increased in height growth when fertilized, while others did not respond or were inhibited (65). Seedlings in plastic bags grew faster than those in metal containers, though growth in metal containers was acceptable (48). Bare-root kadam seedling plantations had 90% survival, and in 23 months had grown to 3.1 m at 45.7 m asl and 1.2 m at 457 m asl (34).

Unpublished research in Puerto Rico with seedlings from two Chittagong Province locations in Bangladesh and one from Malaysia, showed that the provenance from Malaysia was more vigorous ($p < 0.05$) than the two Chittagong provenances. The mean height of the Malaysian seedlings was approximately 50% greater (27.3 cm) than the seedlings of the two Chittagong provenances which averaged 18.1 and 18.7 cm each. The Malaysia seedlings were noted for their larger, succulent leaves, in addition to their more vigorous growth. Several of the Malaysian seedlings suffered extensive insect attack but the attack did not limit their growth. In the field, however, provenance differences were not significant. In two other sites, where the study was replicated, plantings failed after 2 years due to weed competition.

Vegetative Reproduction.—Kadam seedlings coppice vigorously (3, 15, 25). While coppicing will occur in plants of up to about 30 cm in diameter, best results are obtained from stumps 1 cm in diameter (15).

Sapling and Pole Stage to Maturity

Growth and Yield.—Kadam has been hailed as a "miracle" or "wonder" tree (37) partly because of its fast growth rate. Rates of daytime net photosynthesis for mature leaves can be 1.6–14 times higher than nighttime respiration (44). The assimilation ratio (maximum gross photosynthesis [$1.2 \text{ g}/\text{m}^2\cdot\text{day}$]/chlorophyll A [$0.378 \text{ g}/\text{m}^2$]) was very high ($3.3 \text{ g}/\text{g}\cdot\text{day}$ [44]). Water loss by transpiration ranged between 200 and $640 \text{ gH}_2\text{O}/\text{m}^2\cdot\text{day}$ (44).

The tree forms buttresses under flooded conditions, but in well drained areas, it does not. However, 60% to 80% of its straight cylindrical bole is branchless. Taper to 5 m was over 0.8 and as high as 0.89 in favorable sites in Puerto Rico (32). Kadam exhibits monopodial growth, is self-pruning, and has a broad, flat, bulb-shaped crown (22). Average tree height is about 15 to 30 m, and tree diameter at maturity ranges from 30 to 60 cm (7). A characteristic of the species is the variability or patchiness of growth within a

stand (5, 63). Within even-aged plantations, diameters may also vary widely (53). This is attributed to its reaction to patchiness in soil fertility and to genetic variability (63).

Average height growth ranges from 1.8–3.0 m/yr during the first 5 years, slowing down to 0.2–0.9 m/yr after 25 years (32, 55). In Puerto Rico, maximum height is reached within 10 to 20 years and some trees on poor sites develop a spiral trunk twist after about 7 years of growth (32).

Volume increment ranges from 12 to $30 \text{ m}^3/\text{ha}\cdot\text{yr}$ during the first 12 years of growth (32, 55), and volume increases almost linearly with age (fig. 1). Differences in volume yield in stands from different countries are illustrated in fig. 2. For small trees, there is consistency in all studies in the relation between diameter at breast height and volume. A kadam plantation in Puerto Rico accumulated 11.5 t of dry matter/ha.yr, 73% of which was stemwood. Regressions for volume and aboveground biomass against diameter at breast height are summarized in table 1.

In Sabah, diameter growth during early years reached 7.6 cm/yr on good sites and slowed down to 1.3 to 3.8 cm/yr after 3 years (8). Growth rates slow down after 10 years or so on poor sites (15, 32). In Puerto Rico, diameter growth

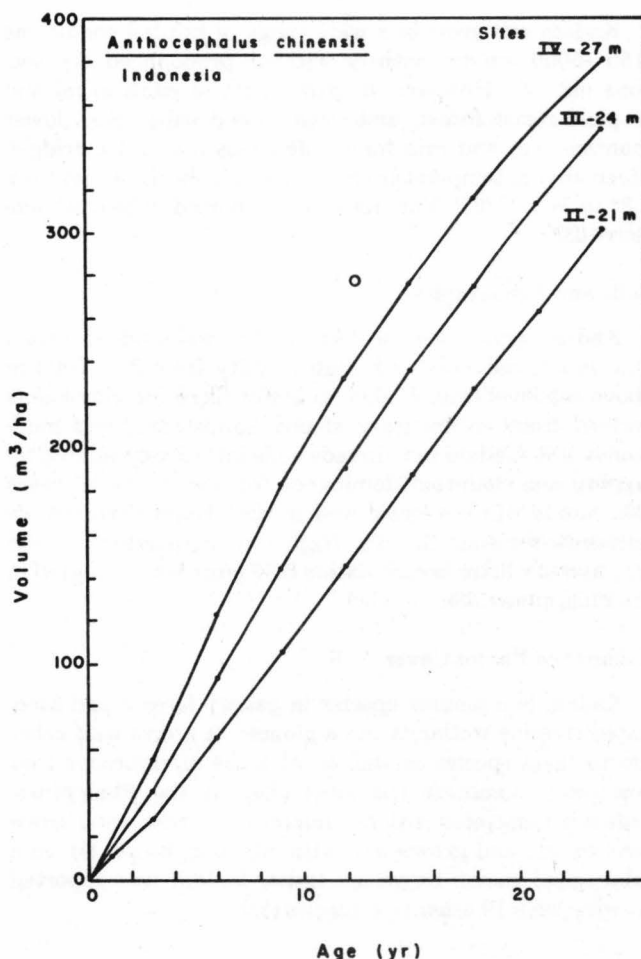


Figure 1.—Volume in plantations of *Anthocephalus chinensis* of different ages. Data are from 55 and 32 (open circle).

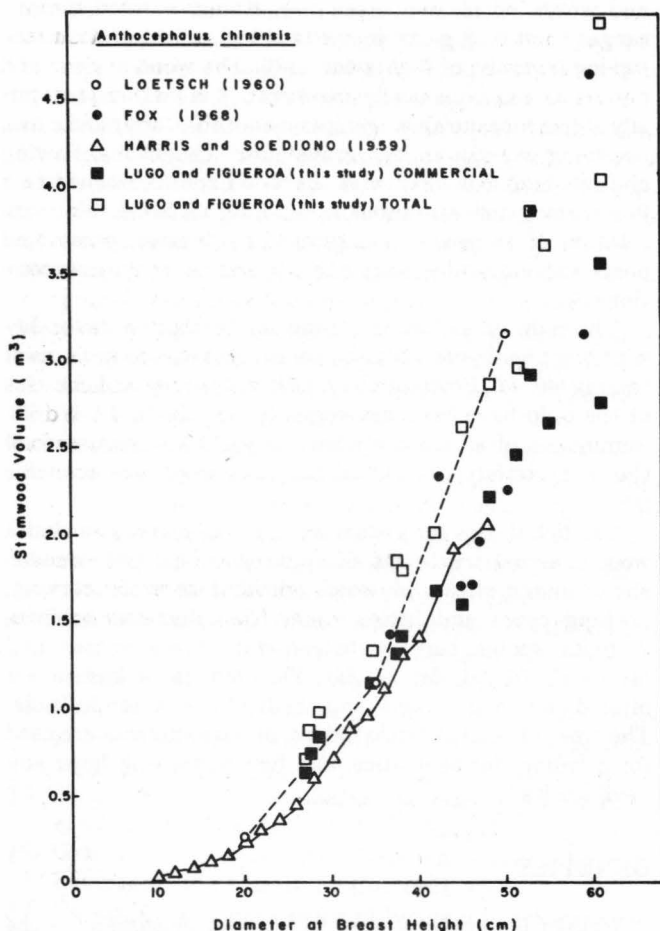


Figure 2.—Relation between individual tree diameter at breast height and volume in plantations of *Anthocephalus chinensis* located in various parts of the world (32).

also slows down after 5 to 10 years, but basal area growth on favorable sites does not. For example, basal area growth in one site was above 100 cm²/yr for 25 years and remained positive after 52 years (32). In India, growth is negligible between the second week of October and the second week of November (51).

Rooting Habit.—The root system tends to be shallow (44), although kadam also forms a tap root in well-drained soils (24, 44) and stilt roots under flooded conditions (15). The root biomass of a 2 year old tree (15.9 cm dbh) was 20% of its total biomass or 6.2 kg (44).

Reaction to Competition.—Kadam is intolerant to shade and does not grow well under its own canopy (15). Gas exchange studies of kadam seedlings (31) and mature leaves (44) have shown net daytime photosynthesis to be positively related to light intensity.

In dense stands, kadam growth is stunted (15). In the Philippines, close spacing (trees 1.0 m to 1.5 m apart) resulted in higher volume yields, although trees had smaller diameters and shorter merchantable wood lengths (35). Better form and faster initial growth rate were obtained with spacing wider than 2 m × 1 m but total volume yield decreased (fig. 3 [50]). In India, spacing did not influence volume yield on a poor site (52). However, sur-

Table 1.—Aboveground biomass and volume relation of 14 *Anthocephalus chinensis* trees in Puerto Rico. Plantation age was 12.5 yr. Equations are of the form: $\ln y = a + b \ln x$, where x = dbh in cm. All F ratios are significant to $p = 0.01$ (32)

Y	a	b	r ²	F ratio
Total biomass, kg	-2.25	2.42	0.97	434
Stemwood biomass, kg	-1.81	2.22	0.97	389
Primary branchwood biomass, kg	-8.08	3.48	0.88	86
Secondary branchwood biomass, kg	-5.80	2.60	0.84	62
Leaf biomass, kg	-4.02	2.03	0.79	44
Fruit biomass, kg	-11.30	3.69	0.73	32
Total volume, m ³	-7.16	2.12	0.98	569
Commercial volume, m ³	-6.67	1.92	0.97	463

vival was better at wider spacings and rectangular spacing yielded better growth than square spacing. Faster growth rates were measured in line plantings (3 m × 7.6 m) and wide spacing (3 m × 3 m) in experiments performed in Puerto Rico (32). Trees in spacings of 0.76 m × 0.76 m grew poorly (32).

Damaging Agents.—Reports of root-knot nematode (*Meloidogyne incognita*) attacks on roots of kadam exposed the vulnerability of this "miracle" tree (46). These attacks cause leaf yellowing, deformed and brittle roots, and enlargement of the root collar. In the Philippines, 97% of the nursery seedling stock was infected by root-knot nematode, causing seedlings to be shorter, weigh less, (both in terms of stem and total weight) and have fewer leaves than controls (49). Soil fumigation was used with some success to mitigate this disease (19).

In Costa Rica, an unknown disease caused kadam planting to cease in that country (18). The disease only attacked kadam and appeared to be a root infection. Its action was patchy, exhibiting early signs of mortality to feeder roots, and staining of sapwood and cambial tissue, particularly on the side of the tree that was infected. The disease was first noted in 1967, 2.5 years after planting. Diseased trees, which eventually died, had small, chlorotic leaves that soon fell. Other insects and borers also attacked moribund trees. Eventually, over 60% of the plantation was killed. The disease was more severe in deep, well-drained soils, and less severe in water-logged soils. Planting of other species on the site did not result in their infestation. *Cylindrocladium parvum* was associated with the disease, but inoculation tests were negative. Reports of a similar disease on kadam occurred in Panama, Trinidad, and Colombia. Seed source for these countries were five trees introduced to Puerto Rico in 1930. Trees in Puerto Rico are disease-free, although thrips (*Selenothrips rubrocinctus*) attack trees and reduce their leaf area, but do not kill them (9).

One-year old mixed plantations of kadam and *Albizia falcata* in east Java were attacked by grubs of *Lepidiotia stigma*, *Leucopholis rorida*, and *Holotrichia helleri*. Tap roots were damaged and the root collar "peeled out" (24). Infestations by *Mycena citricolor* ("ojo de gallo"), a fungus that attacked only kadam and coffee trees, were reported in Costa Rica (2). Leaf-mining larvae of moths, leaf-feeding beetles, sucking scale insects, and other insects have been observed in a 1- to 4-year-old plantation of kadam in the Philippines (17).

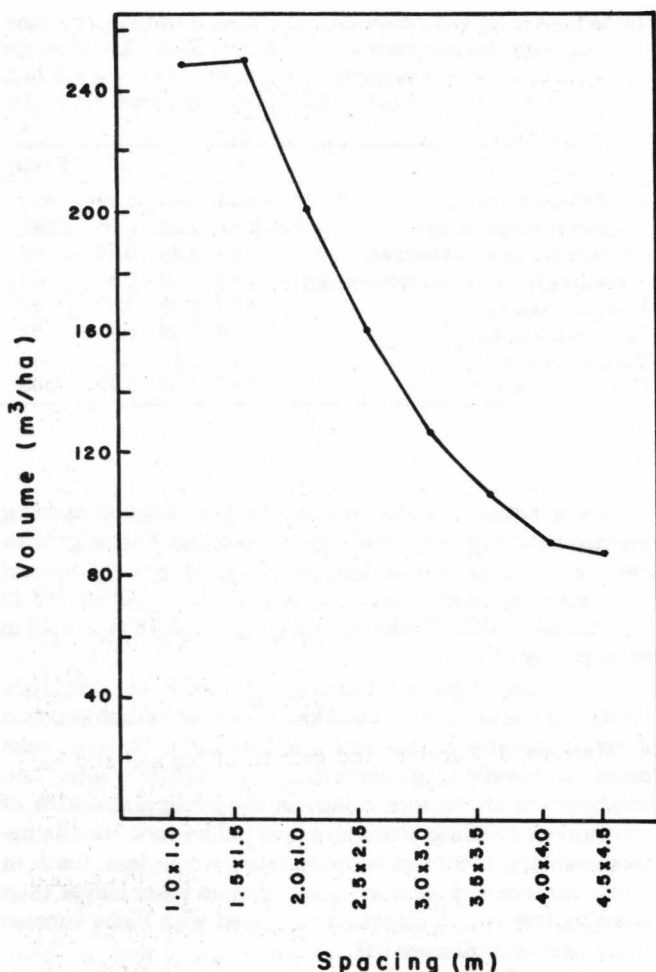


Figure 3.—Effect of spacing on volume yield of plantations of *Anthocephalus chinensis* (35).

In its natural habitat, kadam is susceptible to defoliation, insect attacks, and vine smothering (15). These agents cause stagnation of growth and result in the formation of tapered stems. Three types of caterpillars may cause defoliation (15), which occurs mostly after the rains between August and September (58). Young plants recovered rapidly from defoliation by the moth *Margaronia hilaralis* Wks, a common kadam pyralidid-defoliator in Sabah (57). Control against this moth is normally not needed. However, 0.05% of Gammexane (20%) emulsifiable concentrate in water yielded good control in excessive defoliation cases. Without the presence of defoliators, leaves will normally drop after the first drought (10). Details of some of the life history of defoliators and their natural control agents are available (58).

SPECIAL USES

Because kadam is a fast-growing pioneer species in high rainfall areas and can invade severely disturbed sites, it is a valuable tree in terms of the soil, streambank, and watershed protection its broad canopy affords. Its rapid growth also makes it useful for preventing the invasion of vines

and weeds on cleared areas (45). Kadam's wood density ranges from 0.38 g/cm³ in the butt-log to 0.55 g/cm³ in the top-log (average of 0.45 g/cm³ [38]). The wood is clear and porous and seasons easily. However, it is neither structurally strong nor durable, and it is unsuitable for exterior use, perishing rapidly under "grave-yard" conditions. Sawing and machining is easy, and the wood can be worked to a fine surface without problems (6, 11, 29, 37, 59). A minimum rotation of 15 years is suggested for lumber, poles, and posts although other uses may require 20- to 30-year rotations (55).

The pulp of kadam is strong and compares favorably with most hardwood pulps on the market except in terms of tearing (40, 43). Procedures for pulp extraction and the uses of the pulp have been developed (4, 12, 39, 41, 42, 56, 62). Summaries of all these studies, as well as a discussion of the characteristics of kadam pulp and wood, are available (13).

The list of uses for kadam wood is extensive. It includes wood-charcoal treatment of sugarcane basi (30), wooden shoes, match sticks, plywood, pencil slats, wood carving, packing cases and boxes, splint manufacture, bobbins, dugouts, spools, turnery, beams and rafters, veneer, and others (1, 15, 26, 28, 37, 59). The flowers of kadam are offered at Hindu shrines, and the fruits are eaten in India. The tree is used for cattle fodder, and its extracts are used for gargling, for aromatics, and for combatting fever and "evil spirits."

GENETICS

Kadam is closely related to *Nauclea orientalis* L., the bangkal tree (37), and tends to be confused with *Chinchona succirubra* Pav. and *Nuclea horsfieldii* (45). Its patchy growth in even-age plantations could be due to genetic variability (63).

SELECTED REFERENCES

1. Barefoot, A. C. and A. B. M. Salehuddin. Variation of moisture in tropical veneer. *Emp. For. Rev.* 41: 220–223; 1962.
2. Bazan de Segura, C. Ojo de gallo (*Mycena citricolor*) en kadam (*Anthocephalus cadamba*). *Turrialba* 19(4): 553–554; 1969.
3. Browne, F. G. Forest trees of Sarawak and Brunei and their product. Kuching, Sarawak: Government Printing Office; 1955. 369 p.
4. Cabotage-Sauld, E. and P. M. Nicolas. Dissolving pulps from kaatoan bangkal. *Philipp. Lumber*. 1967 Aug: 10–16.
5. Chinte, F. O. Silvicultural studies of four pulpwood species. *Philipp. Lumber*. 1971. May: 8–26.
6. Chudnoff, M. Void volume wood: An any-tree whole-tree use concept. *For. Prod. J.* 22(6): 49–53; 1972.
7. Chudnoff, M. Tropical timbers of the world. Madison, WI: USDA, Forest Service, Forest Products Laboratory; 1979. p. 559–560.

8. Commonwealth Forestry Institute. Fast growing tropical tree species. Ref. TT/5/1. Oxford, England: Commonwealth Forestry Institute, Department of Forestry, University of Oxford; 1966. [mimeo].
9. Cordell, C. E. and P. J. Barry. Insect and disease conditions—Puerto Rico and the United States Virgin Islands. Report 77-1-2 USDA, Forest Service, Southeastern Area, State and Private Forestry, Forest Insect and Disease management; 1976. 47 p.
10. Corner, E. J. H. Wayside trees of Malaya. Vol. I. Singapore: Government Printing Office; 1951. 772 p.
11. DaCosta, E. W. B. and L. D. Osborne. Comparative decay resistance of twenty-six New Guinea timber species in accelerated laboratory tests. *Commonw. For. Rev.* 46: 63–74; 1967.
12. Escolano, J. D. and E. R. Palmer. 1968. The evaluation of *Anthocephalus cadamba* for dissolving pulp. London: Tropical Products Institute. 1968; Ministry of Overseas Development Report L-13. UK. 15 p.
13. Fenton, R., R. E. Roper and G. R. Watt. *Anthocephalus chinensis*. Lowland tropical hardwoods. An annotated bibliography of selected species with plantation potential. Wellington, New Zealand: External Aid Division, Ministry of Foreign Affairs; 1977: AC1-39.
14. Fox, J. E. D. Some data on the growth of *Anthocephalus cadamba* (Roxb.) Miq. in Sabah. *Malay. For.* 31(2): 89–100; 1968.
15. Fox, J. E. D. *Anthocephalus chinensis*, the Laran tree of Sabah. *Econ. Bot.* 25(3): 221–233; 1971.
16. Gamble, J. S. A manual of Indian timbers. London: Sampson, Law, Marston & Co.; 1922. 866 p.
17. Garcia, M. L. Insect pests of bangkal (*Anthocephalus chinensis*). Wood Preservation Report College, Laguna, Philippines: Forest Products Research Institute, University of the Philippines: 1960; 3(3): 1–12.
18. Gibson, I. A. S. and J. Nylund. Sudden death, a disease of kadam (*Anthocephalus cadamba* (Roxb.) Miq.). *Commonw. For. Rev.* 55(3): 219–227; 1976.
19. Glori, A. V. and B. T. Postrado. Control of root-knot nematode (*Meloidogyne incognita* (Kofoid and white) Chitwood) on kaatoan bangkal (*Anthocephalus chinensis* (Lamk.) Rich. ex Walp.) by soil fumigation. Research Note No. 3. Philippines: Reforestation Administration; 1969. 6 p.
20. Griffith, A. L. Snowfall in Dehra Dun. *Ind. For.* 71: 117–118; 1945.
21. Grijpma, M. C. G. Germinacion y supervivencia al repique de *Anthocephalus cadamba* Miq. *Turrialba* 18(4): 409–415; 1968.
22. Harris, I. M. and J. Soediono. Normal volume-table for *Anthocephalus cadamba* Miq. (Djabon). Indonesia: Forest Research Institute; 1959. Communication 59. 12 p.
23. Hellinga, G. Houtsoorten voor aanplant op bedrijfs-grootte. *Tectona* 40: 179–229; 1950.
24. Intari, S. E. and D. Natawiria. Hama vret pada pesemaian dan tegakan muda. Bogor, Indonesia: Lembaga Penelitian Hutan; 1973; Laporan No. 167. 22 p.
25. Keith, H. G. The timbers of North Borneo. Sadakan, North Borneo: Forest Department; 1947. Forest Records No. 3. 154 p.
26. Khan, S. A. Pencil wood studies. *Pakistan J. For.* 1963 Oct: 367–369.
27. Kraemer, J. H. Native woods for construction purposes in the South China Sea region. Washington, DC: Navy Department, Bureau of Yards and Docks; 1945. 277 p.
28. Kumarasamy, K. and P. K. Balan Menon. Scope of indigenous woods in match manufacture. *Malay. For.* 29(3): 133–139; 1966.
29. Lauricio, F. M. and S. B. Bellosillo. The mechanical and related properties of Philippine woods. *Lumber.* 1966 Aug.–Sept.: 60-66H.
30. Laxamana, N. B. Activated kaatoan bangkal wood-charcoal treatment of sugarcane Basi. II. *Philipp. Lumber.* 1972 Apr.: 40–43.
31. Lugo, A. E. Photosynthesis studies of four species of rain forest seedlings. Oak Ridge, Tennessee: A Tropical Rain Forest, U. S. Atomic Energy Commission Division of Technical Information. 1970. p. I81–I102.
32. Lugo, A. E. and J. F. Figueroa. Performance of *Anthocephalus chinensis* in Puerto Rico [In Press].
33. Manubag, J. M. Litter weight and soil compaction under stands of *Anthocephalus chinensis*, *Swietenia macrophylla* and mixed dipterocarps. *Pterocarpus* 2(1): 22–25; 1976.
34. Marrero, J. Survival and growth of bagged and bare rooted Honduras pine, cadam, and primavera. Res. Note ITF-3. Rio Piedras: USDA, Forest Service, Institute of Tropical Forestry; 1968. 4 p.
35. Maun, M. M. Survival and growth of kaatoan bangkal. *Sylvatrop* (Philipp. For. Res. J.) 5(3): 213–220; 1980.
36. Meijer, W. Regeneration of tropical lowland forest in Sabah, Malaysia forty years after logging. *Malay. For.* 33(3): 204–229; 1970.
37. Monsalud, M. R. and F. R. Lopez. Kaatoan bangkal a "wonder tree". *Lumber.* 1967 Jan.: 60–64.
38. Murphy, P. G. and S. Partadisastra. The physical properties of cadam (*Anthocephalus cadamba* Miq.). New York State University. College of Forestry, Syracuse University, and USDA, Forest Service, Institute of Tropical Forestry, 1963. 29 p. [Unpublished].
39. Najasapoetra, S. Pembuatan pulp djenis kayu daun dengan proses soda dingin. *Rimba Ind.* 9: 278–283; 1964.
40. Nicolas, P. M., J. R. Navarro and L. A. Ynalvez. Kraft pulping of some Philippine hardwoods. *Tappi* 50(5): 113A–115A; 1964.
41. Nicolas, P. M. and C. H. Ballon. Alkaline pulping of Kaatoan bangkal. *Philipp. Lumber.* 1968 August: 22–28.
42. Nicolas, P. M. and C. H. Ballon. Cold-soda pulps from Kaatoan bangkal. *Philipp. Lumber.* 1969 March: 26A–26D.
43. Nicolas, P. M. and O. B. Tadena. Bleached chemi-mechanical soda pulp from Kaatoan bangkal (*Anthocephalus chinensis* Lamk. Rich. ex Walp.). *Philipp. Lumber.* 1970 October: 14–18.
44. Odum, H. T., A. E. Lugo, G. Cintrón and C. Jordan. Metabolism and evapotranspiration of some rain forest plants and soil. Oak Ridge, Tennessee: A Tropical Rain Forest, U. S. Atomic Energy Commission Divi-

- sion of Technical Information. 1970. p. I103 - I164.
45. Paa, N. F. and J. A. Gerardo. Silvical characteristics of Kaatoan bangkal, *Anthocephalus cadamba* (Roxb.) Miq. Philipp. Lumber. 14(9): 57 - 63; 1968.
 46. Padre, E. S. 'Miracle' tree is in trouble. Philipp. Lumber. 1968 June: 14.
 47. Pollard, J. F. A note on the nursery treatment of two species in Sabah. Malay. For. 32(3): 269 - 271; 1969.
 48. Ponce, S. A. and P. Grijpma. Ensayo comparativo de cuatro tipos de recipientes para produccion de plantas forestales. Turrialba 20(3): 333 - 343; 1970.
 49. Postrado, B. T. and A. V. Glori. Root-knot nematode: potential threat to Kaatoan bangkal (*Anthocephalus chinensis*, (Roxb.) Miq.) Philipp. Lumber. 1968 Oct.: 40 - 41.
 50. Shim, P. S. *Octomeles sumatrana* in plantation trials in Sabah. Malay. For. 36(1): 16 - 21; 1973.
 51. Shukla, R. P. and P. S. Ramakrishnan. Phenology of trees in a subtropical humid forest in north-eastern India. Vegetatio 49(2): 103 - 109; 1982.
 52. Singh, S. P. and L. Purushottam. Effect of different spacing treatments on yield from *Anthocephalus chinensis* plantations. Ind. For. 108(12): 734 - 740; 1982.
 53. Soeharlan, A. Preliminary stand table of *Anthocephalus cadamba* Miq. Rimba Ind. 12(1): 37 - 46; 1967.
 54. Stephens, G. R. Assimilation by kadam (*Anthocephalus cadamba*) in laboratory and field. Turrialba 18: 60 - 63; 1968.
 55. Sudarmo, M. K. Tabel-Tegakan sementara dari *Anthocephalus cadamba* Miq. (jiabon) [Preliminary yield-table of *Anthocephalus cadamba* (jiabon)]. Bogor, Indonesia: Forest Research Institute. 1957; Communication 59. 13 p. [In Javanese, English Summary].
 56. Tamolang, F. N., T. M. Lindayen, J. Meniado, and I. Zamuco. Kaatoan bangkal grows in Mt. Makiling. For. Leaves 12(4): 67 - 70; 1960.
 57. Thapa, R. S. Bionomics and control of laran defoliator, *Margoronia hilaralis* Wkr. (Lepidoptera: Pyralidae). Malay. For. 33(1): 55 - 62; 1970.
 58. Thapa, R. S. and R. S. Bhandari. Biology, ecology, and control of kadam defoliator *Arthroschista hilaralis* Walk (Pyralidae, Lepidoptera) in plantations in West Bengal. Ind. For. 102(6): 388 - 401; 1976.
 59. Trotter, H. The common commercial timbers of India. Dehra Dun, U. P., India: Vasant Press; 1944. 289 p.
 60. Troup, R. S. The silviculture of Indian trees. Vol. 2. Oxford, England: The Clarendon Press; 1921. 783 p.
 61. Venator, C. R. and J. A. Zambrana. Extraction and germination of kadam seed. Res. Note ITF-14A. Rio Piedras, P. R.: USDA, Forest Service, Institute of Tropical Forestry; 1975. 3 p.
 62. Villanueva, E. P., J. O. Escolano, and P. V. Bawagan. An evaluation of three-year old Kaatoan bangkal (*Anthocephalus chinensis* Rich. ex. Walp.) for printing and writing paper manufacture. Philipp. J. For. 22(1 - 4): 33 - 44; 1973.
 63. Whitmore, T. C. Tropical rain forests of the far east. Oxford, England: Clarendon Press; 1975. 282 p.
 64. Worthington, T. B. Ceylon trees. Colombo, Ceylon [Sri Lanka]: The Colombo Apothecaries Co., L. T. D.; 1959. 438 p.
 65. Zabala, N. Q. and V. Manarpaac. The effects of fertilization on growth of Kaatoan bangkal seedlings. Philipp. Lumber. 1968 Aug.: 36 - 41.